

Space News Roundup

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National Aeronautics and Space Administration

News Briefs

JSC awards contract

JSC intends to award a cost-plus-fixed-fee contract to McDonnell Douglas Astronautics Co., Houston Division, covering Space Transportation System engineering and operations support. Valued at \$28.2 million, the one-year contract will cover technical and analytical support in engineering systems analyses, new capability development and management systems support. Additional options are estimated at \$20.2 million. The contract is a follow-on to two existing contracts with the company. The work will be performed at JSC and at McDonnell Douglas Houston facilities.

Marshall Director named

Dr. James C. Fletcher, NASA Administrator, announced Aug. 5 the appointment of James R. Thompson as Director of the Marshall Space Flight Center, Huntsville, Ala., effective in late September. Thompson, 50, has been the deputy director for technical operations at the Princeton Plasma Physics Laboratory since April 1983. From March to June of this year he served as the vice-chairman of the NASA taskforce inquiring into the cause of the Space Shuttle *Challenger* accident. Before assuming his position at Princeton University, Thompson spent 23 years with NASA at Marshall, where he managed development of the Space Shuttle's main engine for eight years. He also worked in the Skylab program and was Associate Director of Engineering at the Center.

OSC to roll out new stage

Orbital Sciences Corporation (OSC) and Martin Marietta Denver Aerospace plan to roll out the first Transfer Orbit Stage (TOS) at a ceremony August 20 at the Martin Marietta plant in Littleton, Colorado. The ceremony culminates the three-year TOS development program conducted by Martin Marietta under contract to OSC. Unlike previous space vehicle programs, TOS design, manufacturing and testing have been funded entirely by private investment. OSC president and chief executive officer David Thompson stated, NASA recently selected TOS to launch its Planetary Observer series of spacecraft, and the first TOS flight vehicle is currently committed to launch the Mars Observer spacecraft from the Space Shuttle in August 1990.

Air Force renames base

Sunnyvale Air Force Station, California, has been renamed Onizuka Air Force Station in honor of Lt. Col. Ellison S. Onizuka, who died in the Jan. 28 *Challenger* accident. Air Force Secretary Edward C. "Pete" Aldridge, Jr., said Air Force policy allows renaming installations for deceased members who have made major contributions to the Air Force. The base is the home of the Air Force satellite control facility, which commands and controls spacecraft and supports Space Shuttle flights through its worldwide network of satellite tracking and commanding stations.

Balloon material tested

A new balloon material has helped researchers at the National Scientific Balloon Facility (NSBF) loft a 4,300-pound payload to an altitude of 120,000 feet. Acquisition of the new material and improved manufacturing processes followed a series of balloon failures over the past three years. The NASA balloon program conducts over 50 flights per year to assist in high energy astrophysics research. Most flights originate in Palestine, Texas, and the program is managed by the Goddard/Wallops Flight Facility.



NASA Administrator James C. Fletcher fields questions from employees during a July 25 visit to JSC.

Kerwin issues accident report

Following is the text of a July 28 letter to Rear Adm. Richard Truly, Associate Administrator for Space Flight, from Dr. Joseph P. Kerwin, Director of Life Sciences at Johnson Space Center, on the investigation into the cause of death of the *Challenger* astronauts.

The search for wreckage of the *Challenger* crew cabin has been completed. A team of engineers and scientists has analyzed the wreckage and all other available evidence in an attempt to determine the cause of death of the *Challenger* crew. This letter is to report to you the results of this effort.

The findings are inconclusive. The impact of the crew compartment with the ocean surface was so violent that evidence of damage occurring in the seconds which followed the explosion was masked. Our final conclusions are:

- the cause of death of the *Challenger* astronauts cannot be positively determined;
- the forces to which the crew were exposed during Orbiter breakup were probably not sufficient to cause death or serious injury; and
- the crew possibly, but not certainly, lost consciousness in the seconds following Orbiter breakup due to in-flight loss of crew module pressure.

USAF outlines recovery plan

The Air Force, as part of its plan to recover from the recent setbacks in America's space program, plans a new mixed fleet of expendable rockets, and will defer Shuttle launches from the West Coast until 1992.

Secretary of the Air Force Edward C. "Pete" Aldridge, Jr. said July 31 that the service will buy an additional 13 Titan 34D7 expendable launchers (henceforth to be known as Titan IVs), bringing the total fleet procurement to 23.

The Air Force also will buy 12 new boosters, called the Medium Launch Vehicle, which will be used beginning in 1989 to launch 12 GPS satellites. The Air Force also will modify Titan II missiles for space delivery as part of the Com-

plementary Expendable Launch Vehicle program approved by Congress two years ago, and anticipates flying some 10 to 12 missions each year with this mixed fleet of expendables.

"Since the CELV will play a major role in our recovery planning, that decision two years ago means we're two years closer to recovery," he said.

As for Vandenberg launches, Aldridge said the decision to delay operations there is based on logistics. "The Shuttle is able to place twice as much payload into orbit from KSC as from Vandenberg," he said. "Twenty-one DOD payloads will be sitting on the ground waiting for a flight on the day in February 1988 when the Shuttle

accelerations is from 12 to 20 G's in the vertical axis. These accelerations were quite brief. In two seconds, they were below four G's; in less than ten seconds, the crew compartment was essentially in free fall. Medical analysis indicates that these accelerations are survivable, and that the probability of major injury to crew members is low.

After vehicle breakup, the crew compartment continued its upward trajectory, peaking at an altitude of 65,000 feet approximately 25 seconds after breakup. It then descended, striking the ocean surface about two minutes and forty-five seconds after breakup at a velocity of about 207 miles per hour. The forces imposed by this impact approximated 200 G's, far in excess of the structural limits of the crew compartment or crew survivability levels.

The separation of the crew compartment deprived the crew of Orbiter-supplied oxygen, except for a few seconds supply in the lines. Each crew member's helmet was also connected to a personal egress air pack (PEAP) containing an emergency supply of breathing air (not oxygen) for ground egress emergencies, which must be manually activated to be available. Four PEAP's were recovered, and there

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flies again."

Aldridge said keeping the remaining three Orbiters at Kennedy Space Center makes the best use of the Shuttle fleet and "ensures the backlog of flights—national security, civil, scientific, and foreign—will be reduced as quickly as possible," he said.

Space Station changes reviewed

Administrator Dr. James C. Fletcher has called for a review period of up to 90 days to study a number of important developments and decisions in the Space Station program.

Included in that review are the decisions to realign Station management and work packages and the potential for changes in the baseline configuration of the Station.

Fletcher said "Considerable misunderstanding" has resulted, and he has therefore decided not to implement any decisions for a period of up to 90 days.

Also under consideration are concerns over Shuttle launch capability by the early 1990s and the amount of extravehicular activity necessary to construct the dual keel Station design. The concerns have resulted in reviews of the assembly sequences and some design changes in the baseline configuration, Headquarters said. Any changes would be processed

through normal Station Change Board procedures, and the international partners would be a part of that process.

In any event, the Agency still plans to have a request for proposal for the last phases of the station program on the street as soon as possible, although the planned October deadline for that action does not now look feasible. NASA also plans to have a start of the Phase C/D work in Fiscal Year 1987.

In other Station news, NASA and the European Space Agency (ESA) announced Aug. 1 that they have reached agreement on hardware elements of the Space Station that ESA will carry into preliminary design.

As ratified by Fletcher and ESA Director General Professor Reimar Luest, the agreement marks a major milestone in defining specific Space Station elements in preparation for beginning development of the project next spring.

(Continued on page 2)

Neil Hutchinson leaves NASA

Former Space Station Program Manager Neil B. Hutchinson is leaving NASA to pursue interests outside government service.

Hutchinson headed the program office from its inception on April 1984 to March 1986. His immediate prior duties were as Director of the Space Shuttle Operations Office at NASA Headquarters, Washington, D.C. Apart from that one-year assignment, Hutchinson's NASA career has been entirely at Johnson Space Center.

Since resigning as program manager, Hutchinson has been assistant to the Director of Space Operations at JSC. He joined NASA in 1962 and worked on the design and development of the Mission Control Center's Real Time Computer Complex. He was a flight director for Apollo 17 (the final lunar landing mission), for all three Skylab missions from 1973 to 1974, for the Apollo-Soyuz Test Project in 1975, and for the Space Shuttle developmental and orbital test flights between 1977 and 1982.

In addition to his flight control and flight director responsibilities, Hutchinson served as head of the Systems Logic and Processing Section, Assistant Chief of the Apollo Command and Service Module Systems Branch, Chief of the Guidance and Propulsion Systems Branch, and Deputy Chief of the Flight Director's Office at JSC.

Hutchinson has received numerous awards and citations during his career, including two NASA Exceptional Service Medals and Willamette University's Outstanding Alumni Award. He is a member of the Senior Executive Service.

Hutchinson was born in Portland in June 1940 and graduated from Willamette University, Salem, Ore., in 1961 with a bachelor of arts degree in mathematics and physics. He and his wife, the former Karen L. Zollman of Wichita, Kans., have two children.

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Development Centers selected

The University of Houston is one of four entities selected by NASA last week to establish Centers for the Commercial Development of Space.

The centers are joint undertakings of government, industry and academic teams which will work closely with NASA field centers. The centers are:

- The University of Houston, which will specialize in molecular beam epitaxy;
- The University of Wisconsin, Madison, which will specialize in space automation and robotics.
- Ohio State University, Columbus, which will focus on real time satellite mapping;
- Clarkson University, Potsdam, N.Y., which will focus on commercial crystal growth in space.

In naming this year's teams, Isaac T. Gillam IV, Assistant Administrator for Commercial Programs, said: "This selection is a reaffirmation of NASA's continued support of the Commercial Development of Space. These selectees are expected to make a valuable contribution to our efforts."

The four teams were selected from 25 proposals submitted to NASA based on new and unique research which could lead to commercial activity in space; management teams that are capable of selecting and directing research projects that are commercially oriented; and available non-NASA resources to help operate the center, including the commitment of industrial resources.

ESA studying Space Station options

(Continued from page 1)

The agreement calls for ESA to conduct preliminary design of a permanently-attached pressurized laboratory module and a polar orbiting platform for the remainder of the definition and preliminary design study (Phase B) which extends through early 1987.

Discussion and negotiation on technical details related to the outfitting of the permanently-attached laboratory will continue through the remainder of the Phase B studies. The polar-orbiting platform will be used primarily for Earth observation.

ESA will conduct preliminary design of a man-tended free-flyer (pressurized module and resource module) for international utilization primarily in the fields of material and life sciences and fluid physics, requiring a long-duration undisturbed micro-gravity environment.

In addition, NASA and ESA jointly will study the man-tended free-flyer. This joint study, to be completed by January 1987, will concentrate on user requirements and developmental and operational impacts on the Space Station as a whole and will provide a basis for determination of the utility of the man-tended free-flyer to the Space Station system.

ESA also will study a coorbiting platform based on an enhanced version of their European Retrievable Carrier (EURECA). This platform initially will be ground based. But when the Space Station is operational, the platform will be serviced at the Space Station.

The present agreement covers only the remainder of the Phase B period and does not obligate ESA to develop this hardware. The undertaking of a cooperative program to cover development of the hardware elements will be subject to satisfactory negotiation of an agreement for cooperation in the development, operation and utilization of the Space Station system.

At the direction of President Reagan, NASA is developing a permanently manned Space Station, designed for operation in the mid 1990s, and has invited friends and allies of the United States to participate in the project. As part of that effort, NASA is conducting an 18-month definition and preliminary design study (Phase B) to understand better the technical content, schedule and cost of the program before proceeding with development. A baseline configuration for the Space Station was announced in May 1986, marking the end of the definition phase and the beginning of the preliminary design phase.

Kerwin's accident report closes a chapter

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is evidence that three had been activated. The nonactivated PEAP was identified as the Commander's, one of the others as the Pilot's, and the remaining ones could not be associated with any crewmember. The evidence indicates that the PEAP's were not activated due to water impact.

It is possible, but not certain, that the crew lost consciousness due to an in-flight loss of crew module pressure. Data to support this is:

—The accident happened at 48,000 feet, and the crew cabin was

at that altitude or higher for almost a minute. At that altitude, without an oxygen supply, loss of cabin pressure would have caused rapid loss of consciousness and it would not have been regained before water impact.

—PEAP activation could have been an instinctive response to unexpected loss of cabin pressure.

—If a leak developed in the crew compartment as a result of structural damage during or after breakup (even if the PEAP's had been activated), the breathing air available would not have prevented rapid loss of consciousness.

—The crew seats and restraint harnesses showed patterns of failure which demonstrates that all the seats were in place and occupied at water impact with all harnesses locked. This would likely be the

case had rapid loss of consciousness occurred, but it does not constitute proof.

Much of our effort was expended attempting to determine whether a loss of cabin pressure occurred. We examined the wreckage carefully, including the crew module attach points to the fuselage, the crew seats, the pressure shell, the flight deck and middeck floors, and feedthroughs for electrical and plumbing connections. The windows were examined and fragments of glass analyzed chemically and microscopically. Some items of equipment stowed in lockers showed damage that might have occurred due to decompression; we experimentally decompressed similar items without conclusive results.

Impact damage to the windows was so extreme that the presence or absence of in-flight breakage

could not be determined. The estimated breakup forces would not in themselves have broken the windows. A broken window due to flying debris remains a possibility; there was a piece of debris imbedded in the frame between two of the forward windows. We could not positively identify the origin of the debris or establish whether the event occurred in flight or at water impact. The same statement is true for the other crew compartment structure. Impact damage was so severe that no positive evidence for or against in-flight pressure loss could be found.

Finally, the skilled and dedicated efforts of the team from the Armed Forces Institute of Pathology, and their expert consultants, could not determine whether in-flight lack of oxygen occurred, nor could they determine the cause of death.

Bulletin Board

Bay Area Chorus schedules auditions

The Bay Area Chorus is tuning up for its 22nd Christmas season with auditions and rehearsal. An audition workshop will be held at 2 p.m., Aug. 24 at Webster Presbyterian Church to provide an informal setting to learn about the chorus, to review audition music, and to obtain preliminary voice placement. Rehearsals are from 7 to 9:30 p.m. every Sunday at the Rockwell STSOC cafeteria at 600 Gemini in Clear Lake City. A Christmas concert will be presented Dec. 7 at the NASA Teague Auditorium. The chorus spring benefit concerts in April provide music scholarships to local students planning to enter the field of choral music. The highlight of the 1986-87 season will be a European tour in the summer of 1987. For more information, call Don Pusch at 326-3278 or Harley or Sara Weyer at 333-5585.

Bowling league sets meeting

The NASA-Mixed Bowling League will have an organizational meeting at 5:30 p.m., Aug. 19, in room 222 of the Gilruth Center. All team captains should attend to ensure a place in the league. Proposed changes to league rules should be presented at the meeting. League bowling starts Sept. 2. Anyone interested in joining the league should contact Leona Kain, 282-2544, Dick Wadding, 333-8075, or Floyd Avey, 333-0814.

Bolden to speak at banquet

The Annual Summer Employees Awards Banquet will be held at 11:30 a.m., August 15, in the Gilruth Center banquet room. NASA astronaut Charles F. Bolden, Jr. is the scheduled speaker. Prepaid reservations for the banquet should be made as soon as possible. Checks for the \$5 lunch should be made out to the Gilruth Recreation Center. For further information, call Freda Lowe, ext. 5266.

Fun run set for Sept. 13

A 5 kilometer (3.1 mile) fun run sponsored by the Bay Area Pilot Club is set for 7:30 a.m. Sept. 13 at the University of Houston, Clear Lake, Bayou building. The entry fee is \$7, \$9 on race day, and includes a shirt. First, second and third place male and female runners in eight age groups and wheelchair will receive awards. For more information and an entry form, contact Terry Bantle, ext. 2118.

Jaycees organize golf tournament

The Clear Lake Area Jaycees are scheduling a four-man Florida scramble, best ball, for 9 a.m. Aug. 24 at the Pasadena Municipal golf course. The \$30 entry fee includes green fees and golf cart, and the proceeds will benefit Jaycees community development projects and local charities. Awards go to first, second and third place teams, and a \$25 cash prize goes to golfers with the longest ball and closest to the pin on the front and back nine. For more information and an entry form, contact Joe Pryber at 338-2652.

Technical professionals honored

The Technical Educator, Technical Person and Technical Administrator of the Year were named by the Clear Lake Council of Technical Societies during the third annual awards banquet recently.

The honorees were Dr. Zafar Taqvi, Technical Person of the Year; Dr. Aaron Cohen, Technical Administrator of the Year, and Dr. E. T. Dickerson, Technical Educator of the Year.

The banquet, considered to be the culmination of the year's activities by the nine member organization within CLCTS, began with a keynote speech by Robert G. Minor, President of Rockwell Shuttle Operations Co. Minor focused on the role of technical societies within the JSC community and the technical arena. Individual societies then presented awards and honors to members for their achievements over the past year.

Also honored was Andy Lindberg of Lockheed Engineering and Management Services Co., who was given the Council's Distinguished Service Award for his work this year.

Nominees for the Educator of the Year award were Dr. Rodney Bown, Prof. Max Turner and Dickerson, all of the University of Houston-Clear Lake. Chancellor Thomas Stauffer presented the award to Dickerson.

Nominees for Technical Person of the Year were Lubert Leger of NASA, Dr. Wolf Kohn of LEMSCO and Dr. Taqvi, also of LEMSCO. Dr. Phillip Hopkins, the 1985 winner, presented the award to Taqvi.

Nominees for Technical Administrator of the Year were Ralph Sawyer of NASA, Stan Marrs of S&B Engineering and Dr. Cohen. Henry Bowes, the 1985 winner, presented the award to Cohen.

The CLCTS was formed in 1980 and now has a membership of nine local technical societies.

USAF mothballs Shuttle site

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expendable launch vehicles from the ELV facilities at Vandenberg and ELVs and Shuttles as required from the east coast launch facilities."

The policy calls for assured access to space, and Aldridge stressed that only the first five years of the recovery program have been approved. "An essential point of the recovery plan is that assured access will require a continuing annual expendable vehicle launch rate of about five or six Titan IVs, four MLV, and two Titan IIs."

He said he believes production of the MLV could provide the basis for the development of a commercial U.S. launch industry (Ariane would be excluded from bidding on the MLV work, he said.) "We have required that the competitive bids for the MLV include a variant which will be capable of launching commercial satellites."

The Fiscal Year 1986 urgent supplemental for DOD space recovery, just passed by Congress and approved by President Reagan,

authorizes \$662 million for this fiscal year and has an amendment for another \$801 million in FY 87. "There will be additional funding required in the outyears," Aldridge said.

The Air Force Secretary, who had been scheduled to fly aboard the first Shuttle mission to launch from Vandenberg, said the nation has learned "costly" lessons over the past few months.

"First, if we are to have assured access to space for our most critical DOD payloads—and indeed we must—we cannot afford to rely on a single launch system. As a nation, we made a mistake in the late 1970s deciding that the Shuttle would be our exclusive space launch system. Second, we must have a national space launch capability that is redundant, reliable, and flexible, and that can respond rapidly to our current national launch shortfall. And third, we have learned that space Launch—while highly successful—is still a risky business, and we must be prepared to accept some failures and develop our programs accordingly."



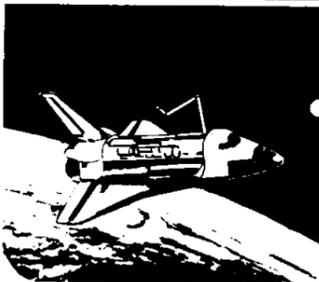
The Fourth Engineering Expo was a success as employees, their families and the public filled two rooms of the Gilruth Center. Displays from the Engineering Directorate's branches ranged from attitude control systems for spacecraft to Shuttle tiles to 3-D television.

NASA
Lyndon B. Johnson Space Center

Space News Roundup

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Editor: Brian Welch



PLAID

The Space Station model made of erector set pieces, plastic bottles and foil hanging in Linda Orr's office in Building 15 is both representative and unrepresentative of the work she does with the PLAID computer aided engineering (CAE) graphics software package. The two are similar in that one can view both the model and a PLAID image of the Space Station from many perspectives and quickly develop a feel for what the Station will look like. On the other hand, the model is crude and difficult to modify, unlike a model in pictures generated by PLAID.

But PLAID is only half of a combination of CAE packages which help Orr, manager of the Graphics Analysis Facility, and Jeri Brown, head of the Crew Interface Analysis Division, to meet the Man Systems Division's goal of providing efficient man/machine interfaces. PLAID models objects like Space Station modules while another program named TEMPUS models the people who work in this environment. PLAID and TEMPUS work together to allow Orr and Brown to find ways to let people interact efficiently with machines.

According to Brown, the development of PLAID began back in 1977, with the initial PLAID product finished in 1979. The PLAID program has been custom built under contract, so the source code for the program can be easily adapted to meet new needs, Brown explained. "We've gone way beyond what was originally conceived for PLAID, and the fact that we were able to modify the program on-site without having to go through a vendor speeded up the evolution of PLAID," Brown said. She added that PLAID has evolved to about 100,000 lines of code "with a lot of synergy between the developers and users."

PLAID has matured quickly, and has been used throughout its development for work on the Space Shuttle and the Space Station.

"PLAID has grown into a very capable program — I don't know of any other system that has all the capabilities that PLAID has," Brown said. As evidence of PLAID's ability, PLAID images were used in the Presidential Commission's report on the Challenger accident. PLAID is also being used to study various emergency egress procedures and mechanisms.

PLAID is also useful for Shuttle mission planning. PLAID helped determine clearances between astronauts and objects and helped locate the foot restraints needed for the Westar and Palapa satellite rescue mission in November 1984. Brown said the ease of using the CAE system aided mission planning because they could produce images depicting a certain rescue plan, obtain useful information from the images, submit the images and data to mission planners, receive feedback and iterate the whole process over again the next day.

In addition to helping mission planning for extra-vehicular activi-

ty, PLAID is used for many other tasks like simulating camera angles and lighting and clearance studies. "With PLAID, we can see the same view that a camera on the RMS (Remote Manipulator System) or in the payload bay would see. With this, we can determine whether or not a given camera location or lens-size will give us the desired view," Brown said. And all of this was determined without spending a minute placing different cameras all around the Shuttle's payload bay.

PLAID also has the ability to simulate the 3-D and geometric properties of objects. PLAID can perform single-point lighting studies which, for example, help ensure that spacecraft solar arrays are covered by sunlight rather than shade. Lighting studies are also made to ensure that an astronaut will not be forced to contend with glare and reflected light. Brown said data pertaining to an object's mass in addition to its size will eventually be included in a data base, so that as the object moves around in the design process, the spacecraft's new center of mass and moment of inertia are easily calculated.

Brown said the flexibility of the PLAID program allows them to easily perform systems engineering work. "For example, we were given a set of requirements for a Space Station module. Using PLAID we can piece components together and see how they fit. We also try to work-in the man/systems integration requirements," Brown said. PLAID's ability to show the views seen from a given location is being used to place windows and cameras on the Space Station.

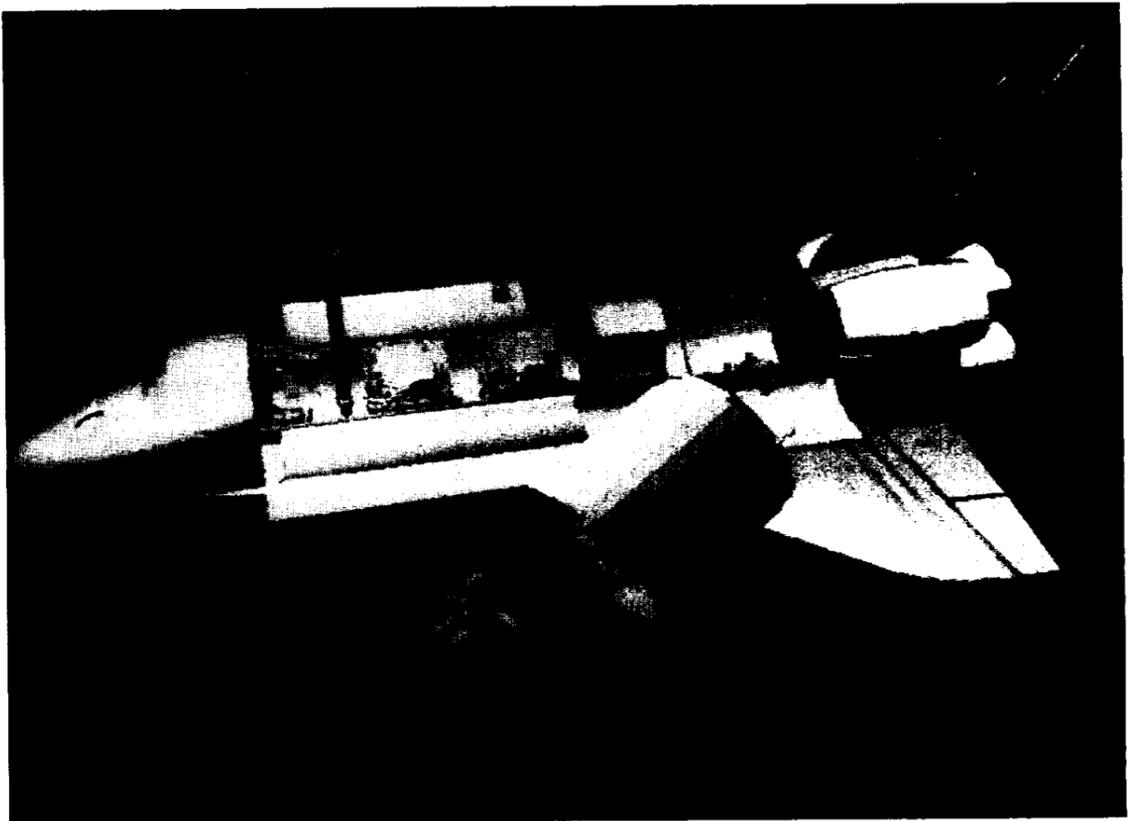
However, Brown said that PLAID may not fit some definitions of a CAE system because it can not dimension the drawings it produces. "But," she added "you can dimension the final drawings by hand, and information concerning dimensions and clearances is always available from PLAID."

PLAID can model any kind of object, including humans, using polygons of various sizes and shapes. But the human images formed by PLAID are difficult to "move" as a human would move. To help fulfill the mission of providing efficient man/machine interfaces, Brown and Orr manage TEMPUS, a program developed at the University of Pennsylvania which works in conjunction with PLAID.

"TEMPUS uses an anthropometric database of the astronauts which contains their heights, arm lengths and things of this nature. Using this data in TEMPUS, we can easily model any astronaut we want. We can model either a 95th percentile male (a man with height, sitting-up height and other characteristics greater than 95 percent of the other men in the database) or the particular attributes of any one astronaut," Orr said.

TEMPUS was written in the Pascal, C and FORTRAN programming languages and models

PLAID (plad), n. 1. a computer program which generates images from patterns of polygons (see computer aided engineering). 2. (archaic) a garment with a criss-cross pattern.



PLAID images were used extensively to assess extra-vehicular activity for the 1984 Westar and Palapa satellite rescue mission.

humans and their movements. "The program only allows possible human movements. For example, a person can't rotate their head 180 degrees, and neither can a TEMPUS person. Moreover, if the user of a TEMPUS program wants to move a model's hand to a certain location on a work station, that's only allowed if the model has sufficient reach. If the model can reach it, the rest of the arm naturally follows the hand's motion to the desired location. Also, if the person you're modeling is especially flexible, we can account for that," Brown said.

Orr said the TEMPUS program is being constantly updated, and JSC and University of Pennsylvania researchers are attempting to develop a way of modeling human strength in the program. Another goal of the effort is to simulate human motion in space by utilizing the equations of motion and the strength of an astronaut.

Design work on the Space Station modules provides an excellent opportunity for PLAID and TEMPUS to work together. Station modules constructed using PLAID provide the environment that TEMPUS astronaut-models work in. Using this environment, workers like Orr and Brown try to design modules that are efficient work spaces.

PLAID and TEMPUS can also work together to provide limited animation which, for example, would show a human model working at a work station. Orr said animation can be used to ensure that a given vehicle layout won't lead to traffic congestion — people bumping into each other while they're trying to work. She said their animation capabilities are limited now, but they can sequence

single images together to get a "quick and dirty" idea of the model's motions. "But we can always look at a single image and get any detailed information we may need," Orr said.

But these CAE programs would not run or yield useful information without extensive supporting hardware. PLAID and TEMPUS run on a VAX 11/785 computer, and Brown said they are procuring a micro-VAX workstation which will be networked with the main VAX. This workstation should lighten the load for an already overworked main VAX. According to Brown, their VAX has a 98 percent utilization rate. To maximize the efficiency of their system, Brown said the software has been modified so that certain CPU-intensive operations like producing hidden-line drawings are done at night. Complex drawings like these can take up to 90 minutes to complete, which still is not too long considering all the calculations necessary to produce a complete hidden-line drawing when the only input to the system was something like "Produce a new image by viewing a reference image from a different angle."

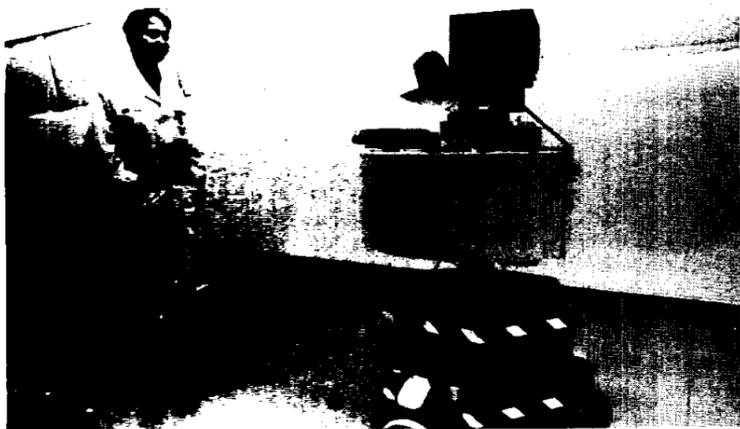
Still, most images are produced very fast. PLAID can produce a full-color, shaded image of the Space Station, viewed from any desired spot, within 30 seconds. Orr explained that images without hidden images are made much faster because PLAID "begins at the back of the image and then assembles polygons together, painting over the rear elements as it moves forward on the image. You wind up seeing the front part of the structure and anything that wasn't painted over."

Input/output equipment which displays the finished product

includes several monochromatic, high-resolution displays with attached printers and high-resolution color displays. One of these color displays has an adaptor which allows users to take Polaroid or 35 mm photos of the image on the display.

One of the more impressive tools is a high-resolution, color monitor which shows changes in perspective in real-time. Using a joystick, one can, for example, "walk around" a wire-frame image of the Space Shuttle and watch the changes in perspective. Zooming in and taking a closer look at any particular item is also possible. This terminal, which was obtained in late June, has already been used to determine how much the Space Telescope can rock back in its cradle in the Shuttle's payload bay before it hits something. Brown said a wire-frame image is produced because the graphics industry does not yet have a system that can handle the complexity of PLAID objects in hidden-line or shaded-image form in real-time motion.

With this real-time capability to "walk around" images and see the changes in perspective, the PLAID/TEMPUS CAE system surpasses almost all the advantages of Orr's hanging Space Station model, without the disadvantages. Using the CAE system, one can see the entire design from every angle, at any magnification. The CAE system also provides detailed information about things like clearances which a real-life model either can't provide or can only provide with actual measurement. But perhaps the best aspect about a CAE model of a design is that the CAE model can be easily rendered and modified, whereas a real-life model, be it a life-size or scale model, can only be built or modified with difficulty.



A robot uses a McDonnell Douglas developed sensor on top of a JSC developed base to follow Anne Marie Ching. The robot uses a video sensor to follow Ching by tracking the contrasting black square on Ching's white lab coat.

Self-guided robot being tested at JSC

A self-guided robot, which is an early-developmental model for future Space Station robots, is being tested in the Tracking Techniques Branch, Tracking and Communications Division, at JSC and also was displayed at the Engineering Exposition July 30 and 31.

The Tracking Techniques Branch is working on robotic servicing as part of an overall robotics development effort headed by NASA's Goddard Space Flight Center. The Branch is developing tracking and vision systems for use by robots onboard the Shuttle as well as the Space Station.

NASA plans to use robots on

Space Station for a variety of routine "outside" jobs. Robots will be used for inspection and maintenance on Space Station, to assemble Space Station payloads such as free-flying platforms or large telescopes, or to retrieve and repair satellites.

Robots will also be used for remote controlled jobs with astronauts giving commands and the robot performing the tasks. This will allow complicated work to be done at remote locations, such as a polar-orbiting platform, without the astronaut's presence.

Space Station tasks will require robots to track moving objects, and the sensor demonstration robot

has that capability. The robot is a tracking system on a mobile platform which uses long and short-range television cameras as "eyes." It is approximately five feet tall and three feet wide and weighs approximately 450 pounds.

Robots sent into space will be more compact, lighter and slimmer. They will be proportionately similar to humans, so they can use the same tools and equipment astronauts use. For example, robots and astronauts will wear the same size manned maneuvering units for extravehicular activities. That way, NASA will not have to design special equipment for the robots.

Roundup Swap Shop

All SwapShop ads must be submitted on a JSC Form 1452. The forms may be obtained from the Forms Office. Deadline for submitting ads is 5 p.m. the first Wednesday after the date of publication. Send ads to Roundup, AP3, or deliver them to the Newsroom, Bldg. 2 Annex, Room 147. No phone in ads will be taken.

Property & Rentals

Lease/Sale: Medical Center 2-2 condo, perfect for students, security, W/D, refrig., pool, very nice, \$600/mo. Herman, x6316 or 488-1259.

Lease: Baywind II condo, 1-1, fpl., all appl., pool, game room and tennis, Jim Wiltz, x5437 or 944-0451.

Lease or Sale: CLC University Green, exec. townhome, 3-2.5-2, large, newly decorated, both formals, den, fpl., patio, deck, \$795/mo. Herman, x6316 or 488-1259.

Lease: Univ. Green Townhouse, 3-2.5-2, pool and tennis, nice yard, \$695/mo. 474-5079.

Lease: 14'x72' mobile home, 3-2, central air/heat, gas & elec., mobile park Friendswood, \$400/mo. including lot. Nita, x5081 or 996-1429.

Sale: 5 wooded acres, 14'x72' mobile home, 3-2, air, attached den, Asutin St., League City, \$59,000. Mohwinkel, 488-3300.

Sale: Baywind II 1-1 condo, fpl., mirrored walls, mini-blinds, ceiling fans, W/D connections, assumable loan. 471-6814.

Sale: Friendswood/Forest Bend townhome, 3-2.5, LR, den, lots of storage space, park, pool, \$49,500. 333-2322.

Lease: University Green patio home, 2-2-2, split bedroom design, 2 oversized garden baths, ex. cond., detached garage, fpl., microwaves, drapes, close to pool, \$595. 488-0500 or 480-6516.

Lease: Clear Lake townhouse 2-2.5-2, fpl., W/D, refrig., ceiling fans, custom drapes, 1240 sq. ft., \$465/mo. Actkinson, x3781 or 482-7061.

Lease: Pipers Meadow, 3-2-2, stove, refrig., fpl., fans, mini-blinds, fenced, \$600/mo. Mary Lou, x3274 or 488-3654.

Sale: Heritage Park 3-2-2, assume mort., new section, formal dining, fenced, clean, landscaped, fpl., large kitchen, fans, mini-blinds, \$73,000 OBO. Tanna, 482-2622.

Sale: '72 Craftmade mobile home, ex. cond., 3-2-2, large covered porch, new AC, central heat, new carpet, all appliances, 12'x5'x10' storage bldg., corner lot in super park. Pat, x3083 or 476-5362.

Lease: Baywind I 2-2 condo, W/D, new carpet, curtains, paint, fpl., mirrored bar, \$425/mo. Cindy, x3289 or 538-1878.

Lease: Egret Bay condo, 2-2-2, W/D, microwave, refrig., fans, fpl., pools, boat ramp, \$450/mo. Lee, x6441 or 480-4548.

Lease: El Dorado Trace condo, 2-2-2, fpl., W/D, wet bar, tennis, sauna, pool, \$450/mo. Pete, x6141 or 480-4525.

Lease: Deer Park 4-2, fenced yard, fpl., 3 years old, \$500/mo. 471-3165 or 472-2876.

Sale or lease: Forest Bend townhome, 2-2.5-2, swimming pool at front door, W/D hookups, avail. 1 Sept. Tom, 482-2575.

Sale: 2-2-1 townhouse, corner lot, whirl pool, large bay windows, blinds, large walk-in closet in every room, built-in microwave, laundry hook-ups, elec. garage doors, \$65,000/neg. David or Dede, 538-1002.

Sale: Countryside, League City 3-2.5-2, large back yard and deck, \$49,900. Ted, x7484 or 554-7234.

Sale: League City, lot, Glen Cove subdivision, 81'x127', \$12,000. Doug, x3296 or 332-0274.

Sale: Bay Ridge subdivision, corner lot, 1450 sq. ft., 2.5 yrs old, 3-2-2, new carpet, paint, mini-blinds, fpl., fenced back yard, cathedral ceiling, below market, lease/purchase considered, \$59,900, approx. \$3,500 move-in. 333-2208.

Sale: Memorial Point Lake Livingston lot, near pool, tennis courts, paved streets, sewer/water, elec., 24 hr. security, below assessed value, owner will finance. 946-3945.

Sale: Red Oak Acres, Seabrook 4-2-2, all brick ranch, huge den with fpl., kit. w/breakfast area, circular drive w/detached garage, stocked pond, \$110,000. 474-7963.

Lake Livingston waterfront house, 3-2, sleeps 8, fully furnished, pier, exc. fishing, skiing, swimming, weekend and weekly rates. 482-1582.

Cars & Trucks

'80 Olds Cutlass Calais, stereo, AC, tilt, cruise, 4 new Michelins, ex. interior, mech. and body, needs new paint (supplied), \$2,950. Bill, x4164.

'74 Fiat X/19, good running condition, current inspection and plates, \$800. 996-0981.

'76 Ford van, manual tran., uses regular gas, new tires, runs great. 482-4874.

'79 VW Rabbit, runs well, good cond., \$1,500. Campbell, x2691 or 488-6494.

'73 Datsun hatch-back, needs paint, has primer, sounds awful, runs great, \$250. Mohwinkel, 488-3300.

'72 LTD, engine and tran. good; '65 Mustang parts. 946-4203.

'71 Olds Cutlass Supreme, eng. good, needs some body work, rebuilt tran., AM/FM stereo, \$950. 480-1233.

'82 Olds Cutlass Supreme, V6, auto, AM/FM, very good cond., 72,000 mi., \$300 above wholesale. Larry, x6121.

'79 Toyota Supra, runs great, new tires, stereo system, moon roof, \$2,200. Carl Nettles, 474-5601.

'76 Plymouth Valiant for parts, good 225/6 motor and 3-spd manual tran., \$150. Ruth, x4757 or 480-4553.

'60 Mercedes Benz 220 Sb, \$3,200. David Schurr, x3486.

'79 Pontiac Bonneville 2 dr, good cond., AM/FM/cass., runs good, \$1,850/neg. Mike, x2383 or 482-0626.

'79 Nova, auto, 6 cyl., new tires, batt., runs great, estate sale, \$1,800. 488-0275.

'84 Nissan 300ZX, red, 5 spd, T-tops, turbo spoiler, window tint, 2 alarm systems, Le Bra, AM/FM/ cass., Cibie fog lights, Formula steering wheel, immac. cond., \$13,000 OBO. Bee Jay, x5451 or 486-8156.

'80 Mustang Cobra, jet black, GT tires, PS, PB, AC, AM/FM/cass., chrome wheels, runs excel., new engine, \$3,600, neg. Lewis, x5251.

'73 Dodge Maxivan, 360 V8, PS, AC, radio, \$500. Rodney, x4393.

'77 Camaro, auto, AM/FM, PS, PB, student, must sell, \$1,400 OBO. 334-1303.

'80 Pontiac Bonneville, 4 dr., V8, blue, 70,000 mi., clean, \$3,700. Rick, x5341 or 480-3017.

'74 T-bird, one owner, 54,000 actual miles, must see to appreciate, \$1,500 firm. 741-6836.

'84 Chevy custom van, V8, auto, 4 capt. chairs, sofa, lots of extras, \$15,800. 481-1382.

'60 Rambler station wagon, needs some work, \$200. Kyle, x2055 or 280-9517.

'84 Dodge Daytona turbo, fully loaded, leather interior, \$9,000 OBO. Michael, x6481 or 480-4540.

'85 Chevy Cavalier, AC, AM/FM, 5 spd, 8,000 mi., price neg. Ann, 332-1292.

'66 Mustang, one owner, 50,000 actual miles, must see, "white." 528-7245.

'85 Honda Accord, 5 spd, 9,000 mi., lease car, 2 door w/hatchback, need someone to take over payments of \$182/mo., 3 yrs left to pay. 471-3165 or 686-4646.

'77 Chevy Corvette, black & red interior, T-tops, good cond., \$7,000/neg. Michelle, x5516 or 925-4243.

'85 Camaro, AT, AC, tilt, cruise, alarm, AM/FM/cass., red, low miles, \$8,600. Matt, x5231 or 486-7260.

'80 Firebird, front end damage, repairable, \$500 as is. L. Tiedt, x4921.

'82 Dodge van, Ram 250, 318 V8, auto, PB, PS, AC, 40,000 miles, ex. cond., \$4,700. 332-7467.

'77 Lincoln town coupe, ex. cond., garaged, loaded, \$2,100. H. C. Mandell, x6557.

'85 Honda CRX, AC, auto, AM/FM/ cass., tinted windows, 13,400 mi., \$6,700. 486-1271 or 476-0450.

Cycles

'82 XL 80 Honda, 900 mi., ex. cond., street legal, \$425 firm. C. Hudgins, x5161 or 334-1303.

'80 Honda 400 MC, 8,600 mi., passenger seat, ex. cond., \$700. Peggy, x6431 or 473-7177.

Boy's 20" BMX bike w/alloy mags, ex. cond. 488-2822.

'84 Schwinn Voyager 11.8, ex. cond., \$200. Sue, x2013 or 482-9408.

'82 Yamaha Virago 920, Cymom instruments, saddle and tank bags, AM/FM/cass., Maxxom 2-way intercom, Plex faring, 7,000 mi., \$1,800. 480-4035.

'79 Suzuki dirt bike, like new, \$450. Michelle, x5516 or 925-4243.

'82 Suzuki GSL 850, good shape, need to sell. Clint, 488-8919.

Boats & Planes

Gulf coast 14 (sunfish clone) sailboat, good cond., ready to sail, \$350. David, 488-3966.

Catamaran sailboat, NARCA 5.2 w/trailer, \$1,800. Rodney, x4393.

16' fiberglass, deep V boat, 115 hp. Mercury outboard, recent repairs to eng. and trailer, \$2,500 OBO; commercial shrimp net w/elec. winch and A-frame, \$800 OBO. Laura, 280-1592 or 485-2627.

Shasta '77 travel trailer, 22' self contained, roof AC, sleeps 8, ex. cond., new tires, \$3,950. 481-8885.

Audiovisual & Computers

Two boxes of 10 diskette Datafile floppies, 5.25" double sided/double density, 16 hard sectors, \$8 per box. Mike, x3881 or 486-0193.

AM/FM cassette stereo w/speakers, \$75. Bosley, x3511.

Stereo component system, EPI speak-

ers, Sherwood receiver, Bic turntable, needs some work, \$350 OBO. Lynn, x3991.

15" Sony Trinitron TV, \$200 OBO. Gary, x5595 or 538-2110.

Magnavox Odyssey 2 video game w/13 cartridges, includes orig. K.C. Munchkin. \$100 OBO. 332-1385.

TRS-80 model 3 computer, 2 disc drives, hundreds of dollars of software including spreadsheets, word processors, games, etc., \$495. Tim, x6156 or 486-9318.

Atari 1200 XL w/1010 program recorder, new in box, \$250. M. Franklin, 280-3580.

Panasonic stereo, AM/FM radio, cassette player, \$50. 944-6457.

Zenith stereo w/cassette, 8 track, ex. cond., \$200; metal credenza, black, like new, \$225. 280-0909.

RVs

Pickup camper top, white w/side windows and sliding cab window, \$95. Nat, x3396 or 474-4228.

Household

Wooden coffee table w/glass top, like new, \$95 OBO. Donzelle, x3336 or 280-0134.

Electric dryer, Wards heavy duty twenty, runs OK, bought newer model, \$50 OBO. Dick, x7238 or 333-1072.

Apartment washer and dryer, gold color, J.C. Penney's model, good cond., \$200. Beverly, x5881 or 943-8113.

Refrigerator, new, GE, almond color, 1,800 cu. ft., \$300. Hughes, 333-6821.

Microwave oven, new GE, full size, \$250. Hughes, 333-6821.

Handcrafted poster bed, full size with canopy frame, \$50. Ted, 480-2367.

All-wood desk, 31"D x 56"W x 34"H, two side drawers, one pre-slotted file drawer, unit in ex. cond., \$100. Richard, 280-1592 or 487-5685.

Gas Kenmore dryer, runs great, best offer. David, 280-1500 x3314 or 338-2368.

Custom bedspread, double, matching drapes, lined, polished cotton, almost new, rust, floor length. Bea, x3989 or 333-2335.

Upright Eureka vacuum cleaner, top of the line, ex. cond., \$35. Bea, x3989 or 333-2335.

Sofa-bed, good cond., needs cleaning, \$85. Mike, x4367 or 996-1468.

Mini refrigerator, 1 yr old, \$65; Whirlpool upright freezer, 16.1 cu. ft., ex. cond., 3 yrs old, \$300. C. Lynn, 483-4031 x21 or 538-1126.

Sell or trade, Kenmore heavy duty gas dryer, white, 4 yrs. old, \$175 or equivalent elec. dryer. Nita, x5081 or 996-1429.

Couch, \$15 OBO. R. Hubbard, x6186 or 488-2205.

De-humidifier, Sears, ex. cond., \$60; large Spanish chandelier, \$65. Gene, x5893 or 488-5162.

3 pc. living room set, sofa, loveseat and arm chair, earth tones, \$250; brown plaid sofa, \$50. Connie, x3844 or 585-4517.

Full size bed w/mattress, \$150; twin storage bed, \$150; dresser, \$50; couch, \$100; OBO on all items, moving, must sell. Brian, 280-0385.

Executive size secretarial desk w/pedestal, \$100. J. Ross, x5111 or 554-5968.

El Toro lawnmower, self-propelled, \$50. Terry, x2504 or 333-2985.

Kenmore sewing machine in cabinet, ex. cond., \$60. J. Ross, x5111 or 554-5968.

Air conditioner, window, Sears, 18,000 Btu, energy eff., 1 year old, 2 mon. use, warranty, \$400. Frank, x5425 or 332-7383.

Approx. 30 sq. yards of emerald green carpet, ex. cond., \$200 OBO. Beth, x3681.

Mahogany coffee & end tables (3), modern style, \$125; Eureka vacuum cleaner, \$55. Sandra, 554-7492.

Bed for sale, twin bed, mattress, box spring, and frame, good cond. \$30. Stephen, x3291.

Student desk w/chair, \$30. 444-6457.

Antiques: Oak wall phone, all working parts, \$225; 1910 mahogany curio cabinet, \$150; wash bowl/pitcher, perfect, \$65; 1860 American mahogany wardrobe, \$1,200. Harry, x4571.

Wildlife art prints, fine quality, 22"x28", signed, \$30 each, 280-0909.

8 drawer dark brown wood desk w/locking center drawer, \$80; matching 9 drawer dresser w/attached mirror, \$120. Vi, x4596.

Pets

Free beautiful black Doberman/German shepard, 2 years old, male, needs country home w/room to run, loves kids, good watch dog. Jerry, x3288.

Exotic blue-fronted Amazon parrot, 20 months, prime to train, w/cage and

all accessories. \$450. M. Franklin, 280-3580.

7/8 Arabian mare w/colt, grey, 9 yrs old, very gentle, super trail mare. 643-2329.

Shiny, black, short-haired, medium sized male dog, very gentle, obedient, well mannered, young, wants to adopt parents, free to good home. Briggs, x5165 or 333-2717.

Golden lab, male, 2 yrs. old, all shots. Shayla, x2555.

Wanted

Mamiya 645 camera body. Chuck, x4241 or 487-2978.

Lead trumpet player for Contraband swing band, a volunteer hobby band. Ray, x6327 or 554-5434.

Roommate wanted for 2-2 house on Seabrook waterfront, must like cats, \$200/mo. plus 1/2 bills. 474-9791.

Want to babysit your child in my home, convenient location, Camino South. 486-5094.

Need a minimum of five persons interested in learning conversational Chinese, a class can be arranged w/Rice instructors. C. Abadie, x3470 or 486-6431.

Want to buy electric trains. Don, x2449.

Need air condition work done at home, auto air cond. also. Richard, x6186 or 488-2205.

Musical Instruments

Back-to-school clarinet outfit, 1 1/2 yr old, very good condition, must sell, \$200. Mary Lou Sprake, x5505 or 334-1345.

Baldwin Overture organ, "The Fun Machine," bench & instruction manuals, \$1,650. Tom Clark, x7445.

Bundy clarinet w/case and stand, ex. cond., \$150. Marie, x3606.

Miscellaneous

Drafting table, 38"x80", must sell, \$50. 334-1345.

Computer terminal, needs repair; 2 trailer hitches, \$15 each. 488-6521.

32 x 11.5 R15 LT, wild country radial PVT tire, like new, raised letters, only one, \$65. 534-4839.

Cemetery lots, Earthman Resthaven Memorial Gardens, I-45 north, 2 spaces in Lutheran section, \$1,390 total price. E. J., x3653 or (409) 539-3994.

Diamond dinner ring, 1.5 carats in an unusual free floating design, appraised at \$3,990, sell for \$2,500. 486-4096.

Inversion exercise machine w/boots, \$150. Connie, x3844 or 585-4517.

Gas edger, ex. cond., \$65; Sears 55 gal. wet and dry shop vacuum, \$55. Gene, x5893 or 488-5162.

Encyclopedia Britannica, complete 30 volume set, 1 yr. old, ex. cond., \$675. C. Lynn, 483-4031 x21 or 583-1126.

Lawnmower w/cast deck, needs drive repair, B&S engine w/magnatron ignition, starts & runs good, \$50 OBO. Dick, x7238 or 333-1072.

Golf clubs, mens right hand, four woods, seven irons, pitching wedge, putter, bag and cart, \$100 OBO. Phyllis, 488-9005 x297 or 895-0543.

Covered utility trailer, fiberglass, single axle w/spare tire, 40"x40"x26", 1,000 lb. gross, great for use w/small car, \$225 OBO; silver flute, \$75. Phyllis, 488-9005 x297 or 895-0543.

8 ft. oak pool table, \$1,200; Hitachi VCR, \$325; Tappan microwave, \$125; Cobra cordless phone, \$75; dining table w/4 chairs, \$35. 486-1271 or 476-0450.

Marlin 336-C 30-30 rifle, ex. cond., 3 boxes of ammo., \$135. 488-3966.

Mini-cross bow, 45 lbs., good silent defense weapon, good cond., 7 darts, \$50. Harold, x2146.

Aquariums, 50 gal. rectangle, complete w/tanks, top, light, stand, outside filter, heater, \$250; 45 gal. hexagon, equipped same as 50 gal., \$250. 643-2329.

Pool table slate, \$150. 482-7814.

Lawnmower, B&S engine, rear bagger, power rake, needs tune-up, \$40. Matt, x5231 or 486-7260.

Hang glider for water skiing, \$400. Terry, x2504 or 333-2985.

Tennis and racquetball rackets, graphite and aluminum types, all new, \$10 and up. 480-6431.

Gilruth Center News

Call x3594 for more information

Tennis lessons — Beginner and intermediate tennis lessons are scheduled to begin Sept. 8 and Sept. 10, respectively. The lessons last eight weeks and run from 5:15 to 6:15 p.m. The cost is \$30.

Ladies weight training — This four-week program begins Aug. 11 and meets from 7 to 8 p.m. every Monday and Wednesday. Cost of the program is \$20.

Softball tournament — Aug. 14 is the registration deadline for the Gilruth Center Softball Tournament, which will take place Aug. 16-17. Trophies will be awarded to winners in men's B, men's C and mixed categories. An \$80, non-refundable entry fee must be turned in with entry forms, and August 23-24 is the scheduled rainout date.

Cookin' in the Cafeteria